CHAPTER 17. ENROUTE CRITERIA

1700.-1709. RESERVED.

Section 1. VHF Obstacle Clearance Areas

1710. ENROUTE OBSTACLE CLEARANCE AREAS. Obstacle clearance areas for enroute planning are identified as "primary," "secondary," and "turning" areas.

1711. PRIMARY AREAS.

a. Basic Area. The primary enroute obstacle clearance area extends from each radio facility on an airway or route to the next facility. It has a width of 8 NM; 4 NM on each side of the centerline of the airway or route. See Figure 17-1.

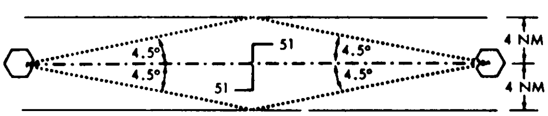


Figure 17-1. PRIMARY OBSTACLE CLEARANCE AREA. Par 1711.a.

b. System Accuracy. System accuracy lines are drawn at a 4.5 degree angle on each side of the course or route. See Figure 17-1. The apexes of the 4.5 degree angles are at the facility. These system accuracy lines will intersect the boundaries of the primary area at a point 50.8 NM from the facility. (Normally 51 NM is used.) If the distance from the facility to the changeover point (COP) is more than 51 NM, the outer boundary of the primary area extends beyond the 4 NM width along the 4.5 degree line. See Figure 17-2. These examples apply when the COP is at midpoint. Paragraph 1716 covers the effect of offset COP or dogleg segments.

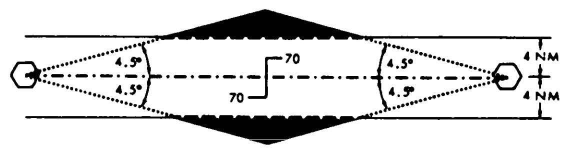


Figure 17-2. PRIMARY OBSTACLE CLEARANCE AREA. Application of System Accuracy. Par 1711.b.

c. Termination Point. When the airway or route terminates at a navigational facility or other radio fix, the primary area extends beyond that termination point. The boundary of the area may be defined by an arc which connects the two boundary lines. The center of the arc is, in the case of a facility termination point, located at the geographic location of the facility. In the case of a termination at a radial or DME fix, the boundary is formed by an arc with its center located at the
* most distant point of the fix displacement area on *
course line. Figure 17-8 and its inset show the construction of the area at the termination point.

1712. SECONDARY AREAS.

a. Basic Area. The secondary obstacle clearance area extends along a line drawn 2 NM on each side of the primary area. See Figure 17-3.

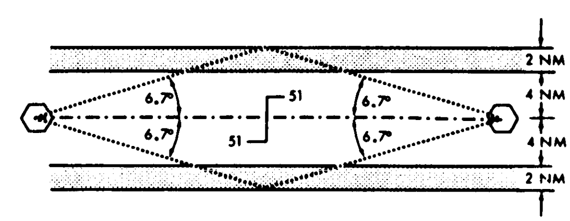


Figure 17-3. SECONDARY OBSTACLE CLEARANCE AREAS. Par 1712.a.

b. System Accuracy. Secondary area system accuracy lines are drawn at a 6.7 degree angle on each side of the course or route. See Figure 17-3. The apexes are at the facility. These system accuracy lines will intersect the outer boundaries of the secondary areas at the same point as primary lines, 51 NM from the facility. If the distance from the facility to the COP is more than 51 NM, the secondary area extends along the 6.7 degree line. See Figure 17-4. See paragraph 1716.c. and d. for offset COP or dogleg airway.

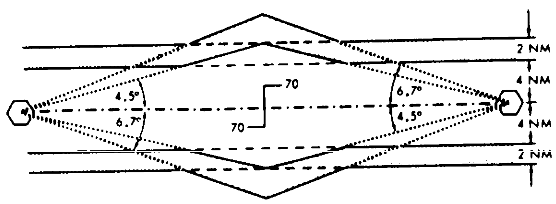


Figure 17-4. SECONDARY OBSTACLE CLEARANCE AREAS. Application of System Accuracy Lines. Par 1712.b.

e. Termination Point. Where the airway or route terminates at a facility or radio fix the boundaries are connected by an arc in the same way as those in the primary area. Figure 17-8 and its inset shows termination point secondary areas.

1713. TURNING AREA.

a. Definition. The enroute turning area may be defined as an area which may extend the primary and secondary obstacle clearance areas when a change of course is necessary. The dimensions of the primary and secondary areas will provide adequate protection where the aircraft is tracking along a specific radial, but when the pilot executes a turn, the aircraft may go beyond the boundaries of the protected airspace. The turning area criteria supplements the airway and route segment criteria to protect the aircraft in the turn.

b. Requirement for Turning Area Criteria. Because of the limitation on aircraft indicated airspeeds below 10,000 feet MSL (FAR 91.70), some conditions do not require the application of turning area airspace criteria.

(1) The graph in Figure 17-5 may be used to determine if the turning area should be plotted for airways/routes below 10,000 feet MSL. If the point of intersection on the graph of the "amount of turn at intersection" versus "VOR facility to intersection distance" falls outside the hatched area of the graph, the turning area criteria need not be applied.

(2) If the "amount of turn" versus "facility distance" values fall within the hatched area or outside the periphery of the graph, then the turning area criteria must be applied as described in paragraph 1714.

c. Track. The flight track resulting from a combination of turn delay, inertia, turning rate, and wind effect is represented by a parabolic curve. For ease of application, a radius arc has been developed which can be applied to any scale chart.

d. Curve Radii. A 250 knot IAS, which is the maximum allowed below 10,000 feet MSL, results in radii of 2 NM for the primary area and 4 NM for the secondary area up to that altitude. For altitudes above 10,000 feet MSL up to but not including 18,000 feet MSL the primary area radius is 6 NM and the secondary area radius is 8 NM. Above 18,000 feet MSL the radii are 11 NM for primary and 13 NM for secondary.

e. System Accuracy. In drawing turning areas it will be necessary to consider system accuracy factors by applying them to the most adverse displacement of the radio fix or airway/route boundaries at which the turn is made. The 4.5 and 6.7 degree factors apply to the VOR radial being flown, but since no pilot or aircraft factors exist in the measurement of an intersecting radial, a navigation facility factor of plus-or-minus 3.6 degrees is used. See Figure 17-6.

NOTE: If a radio fix is formed by intersecting signals from two LF, or one LF and VOR facility, the obstacle clearance areas are based upon accuracy factors of 5.0 (primary) and 7.5 (secondary) degrees each side of the course or route centerlines of the LF facilities. If the VOR radial is the intersecting signal, the 3.6 degree value stated in 1713.e. above applies.

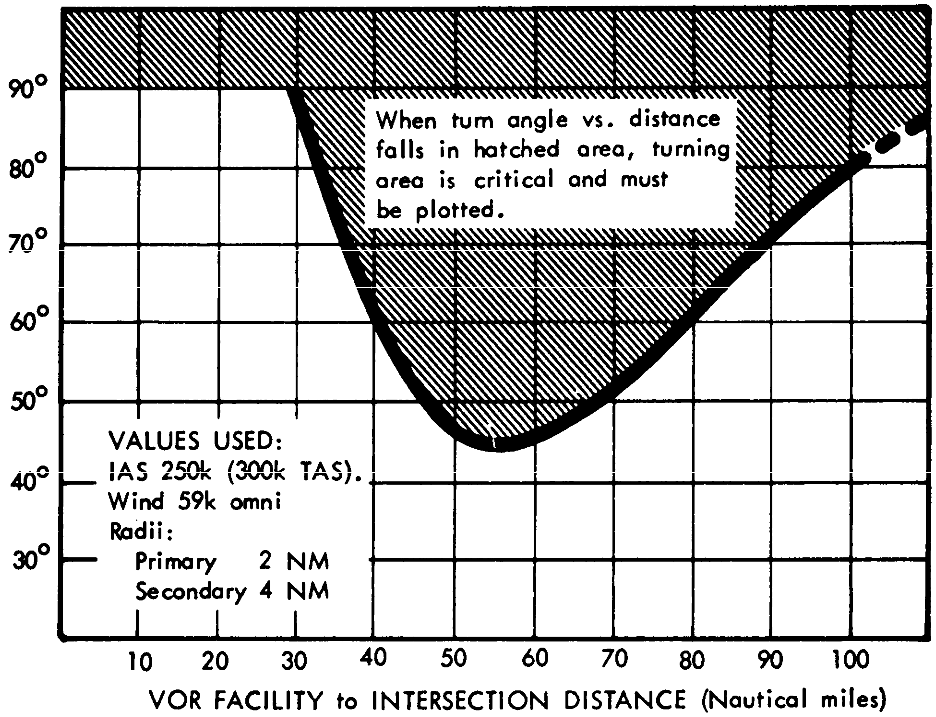


Figure 17-5. TURN ANGLE VS. DISTANCE. Par 1713.b.(1) and (2).

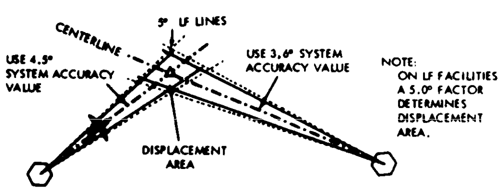


Figure 17-6. FIX DISPLACEMENT. Par 1713.e.

1714. APPLICATION OF TURNING AREA CRITERIA.

a. Techniques. Figures 17-8, 17-9, and 17-10 illustrate the application of the criteria. They also show areas which may be deleted from considerations when obstacle clearance is the deciding factor for establishing minimum enroute altitudes (MEAs) on airways or route segments.

b. Computations. Computations due to obstacles actually located in the turning areas will probably be indicated only in a minority of cases. These methods do, however, add to the flexibility of procedures specialists in resolving specific obstacle clearance problems without resorting to the use of waivers.

c. Minimum Turning Altitude (MTA). Where the application of the turn criteria obviates the use of an MEA with a cardinal altitude, the use of an MTA for a special direction of flight may be authorized. Where this is employed an appropriate notation shall be included on the
* FAA Form 8260-2, Radio Fix and Holding Data Record, for the turning fix. *

1715. TURN AREA TEMPLATE. A turn area template has been designed for use on charts scaled at 1:500,000. See Figure 17-7. It is identified as "TA-1."

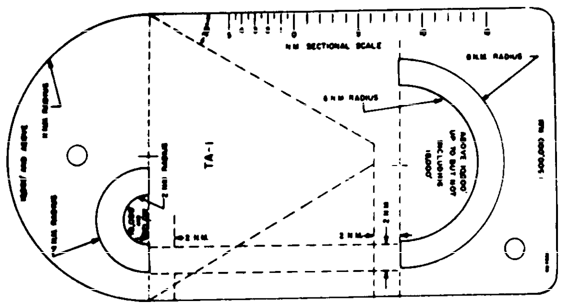


Figure 17-7. TURNING AREA TEMPLATE. Par 1715.

a. Use of Template-Intersection Fix.

(1) **Primary Area.** At an intersection fix the primary obstacle clearance area arc indexes are placed at the most adverse points of the fix displacement area as determined by the outer intersections of the enroute radial 4.5 degree lines (VOR) and the cross-radial 3.6 degree lines (VOR). See Figures 17-8 and 17-9. If LF signals are used the 5.0 degree system accuracy lines apply. The parallel dashed lines on the turn area template are aligned with the appropriate system accuracy lines and the curves are drawn.

(2) **Secondary Area "Outside" Curve.** The outside curve of the secondary turning area is the curve farthest from the navigation facility which provides the intersecting radial. This curve is indexed to the distance from the fix to the enroute facility as follows:

(a) Where the fix is less than 51 NM from the enroute facility, the secondary arc is started at a point 2 NM outside the primary index with the parallel dashed lines of the template aligned on the 4.5 degree line. See Figure 17-8.

(b) Where the fix is farther than 51 NM from the enroute station, the arc is started at the point of intersection of the 3.6 and 6.7 degree lines with the parallel dashed lines of the template aligned on the 6.7 degree line. See Figure 17-9.

(3) **Secondary Area "Inside" Curve.** The inside curve is the turning area arc which is nearest the navigation facility which provides the intersecting radial. This arc is begun 2 NM beyond the primary index and on the 3.6 degree line. The parallel dashed lines on the turning area template are aligned with the 4.5 degree line from the enroute station.

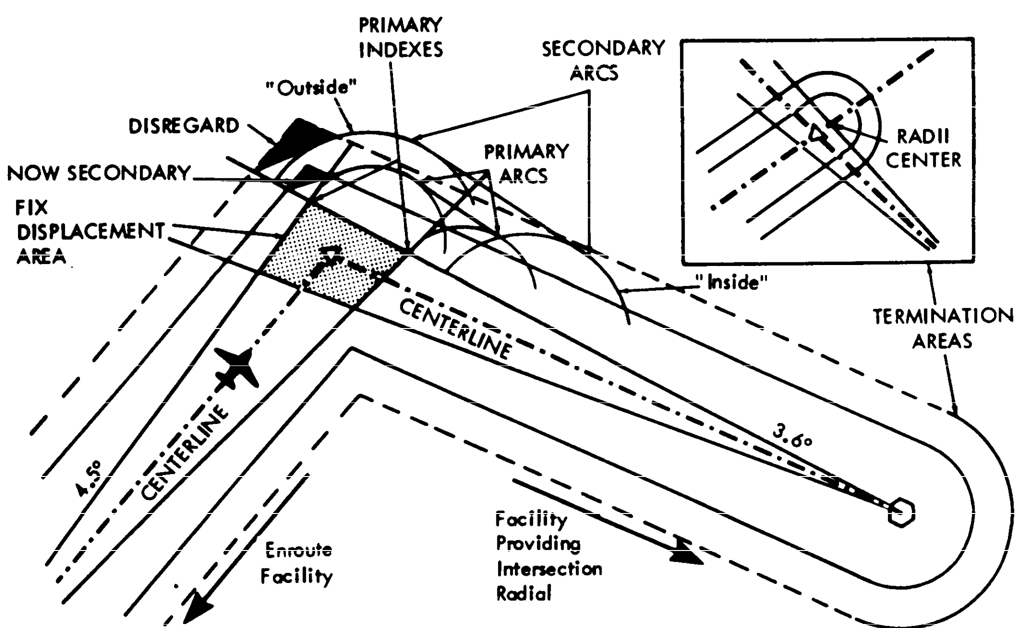


Figure 17-8. TURNING AREA, INTERSECTION FIX. (Facility Distance Less than 51 NM). Par 1715.a. and b.

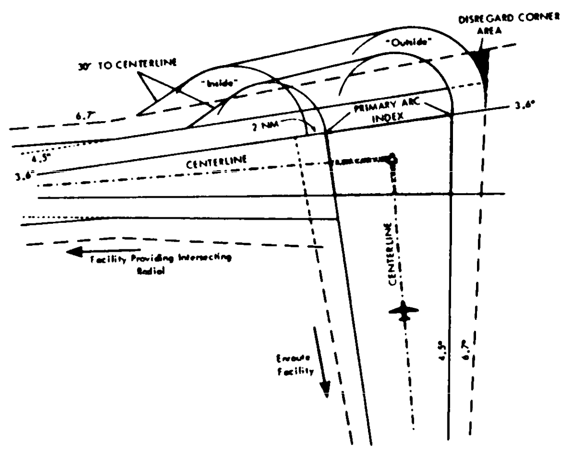


Figure 17-9. TURNING AREA, INTERSECTION FIX. (Facility Distance Beyond 51 NM). Par 1715.a. and b.

(a) Where the fix is less than 51 NM from the enroute facility and the magnitude of the turn is less than 30 degrees, the "inside" curves do not affect the size of the secondary area.

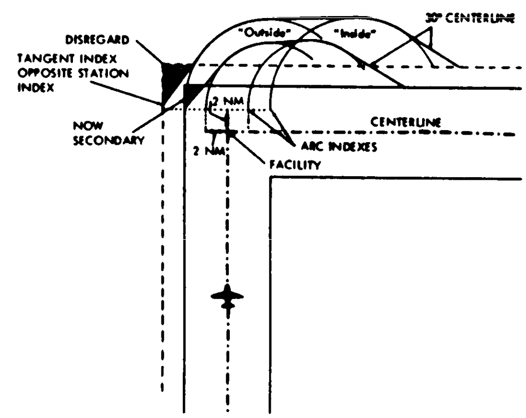
(b) Where the distance from the enroute facility to the fix is more than 51 NM but the magnitude of the turn is less than 45 degrees, the "inside" curves do not increase the size of the secondary area.

(c) Where the magnitude of the turn is greater than those stipulated in (a) and (b) above, the "inside" curves will affect the size of the secondary area.

(d) Whether the secondary area curves affect the size of the secondary obstacle clearance area or not, they must be drawn to provide reference points for the tangential lines described in (4) below.

(4) **Connecting Lines.** Tangential straight lines are now drawn connecting the two primary arcs and the two secondary arcs. The outer limits of both curves are symmetrically connected to the respective primary and secondary area boundaries in the direction of flight by lines drawn at a 30 degree angle to the airway or route centerline. See Figures 17-8 and 17-9.

b. Use of Template When Fix Overheads a Facility. See Figure 17-10. The geographical position of the fix is considered to be displaced laterally and longitudinally by 2 NM at all altitudes.



* Figure 17-10. TURNING AREA - OVERHEAD THE FACILITY Par 1715b. *

(1) **Primary Arcs.** The primary arcs are indexed at points 2 NM beyond the station and 2 NM on each side of the station. The parallel dotted lines on the template are aligned with the airway or route boundaries and the curves drawn.

(2) **Secondary Arcs.** The secondary arcs are indexed 2 NM outside the primary points, and on a line with them. The parallel dotted lines on the template are aligned with the airway or route boundaries, and the curves drawn.

(3) **Connection Lines.** Tangential straight lines are now drawn connecting the two primary and the two secondary arcs. The outer limits of both curves are connected to the primary and secondary area boundaries by intercept lines which are drawn 30 degrees to the airway or route centerline. The 30 degree lines on the template may be used to draw these intercept lines.

c. Deletion Areas. Irregular areas remain on the outer corners of the turn areas. See Figures 17-8, 17-9, and 17-10. These are the areas identified in paragraph 1714 which may be deleted from consideration when obstacle clearance is the deciding factor for determination of MEA on an airway or route segment.

(1) Where the "outside" secondary area curve is started within the airway or route secondary area boundary (see Figure 17-8), the area is blended by drawing a line from the point where the 3.6 degree (5.0 with LF facility) line meets the line which forms the enroute secondary boundary tangent to the "outside" secondary arc. Another line is drawn from the point where the same 3.6 (or 5.0) degree line meets the line which forms the primary boundary, tangent to the matching primary arc. These two lines now enclose the secondary area at the turn. The corner which was formerly part of the secondary area may be disregarded; the part which was formerly part of the primary area may now be considered secondary area. These areas are shaded in Figure 17-8.

(2) Where the secondary curve is indexed on the secondary area boundary formed by the 6.7 degree lines, the arc itself cuts the corner and prescribes the deleted area. See Figure 17-9. This condition occurs when the radio fix is over 51 NM from the enroute navigation facility.

(3) When overheading the facility, the secondary area corner deletion area is established by drawing a line from a point opposite the station index at the secondary area boundary, tangent to the secondary "outside" curve. See Figure 17-10. A similar line is drawn from a point opposite the station index at the primary area boundary, tangent to the primary turning arc. The corner formerly part of the primary area now becomes secondary area. The deletion areas are shown in Figure 17-10 by shading.

1716. CHANGEOVER POINTS (COP). Points have been defined between navigation facilities along airway/route segments which are called "changeover points (COP)." These points indicate that the pilot using the airway/route should "change over" his navigation equipment to receive course guidance from the facility ahead of the aircraft instead of the one behind. These COP divide a segment and assure continuous reception of navigation signals at the prescribed minimum enroute IFR altitude (MEA). They also assure that aircraft operating within the same portion of an airway or route segment will not be using azimuth signals from two different navigation facilities. Where signal coverage from two facilities overlaps at the MEA, the COP will normally be designated at the midpoint. Where radio frequency interference or other navigation signal problems exist, the COP will be at the optimum location, taking into consideration the signal strength, alignment error, or any other known condition which affects reception. The effect of COP on the primary and secondary obstacle clearance areas is as follows:

a. Short Segments. If the airway or route segment is less than 102 NM long and the COP is placed at the midpoint, the obstacle clearance areas are not affected. See Figure 17-11.

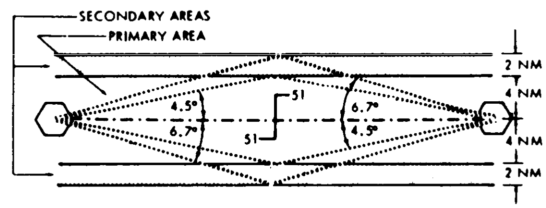


Figure 17-11. COP EFFECT. Short Airway or Route Segment. Par 1716.a.

b. Long Segments. If the distance between two facilities is over 102 NM and the COP is placed at the midpoint, the system accuracy lines extend beyond the minimum widths of 8 and 12 NM, and a flare results at the COP. See Figure 17-12.

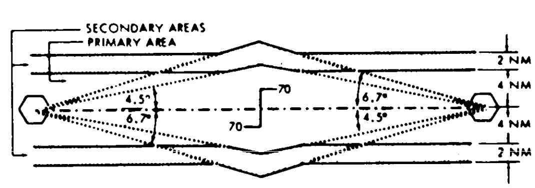


Figure 17-12. COP EFFECT. Long Airway or Route Segment. Par 1716.b.

c. Offset COP. If the changeover point is offset due to facility performance problems, the system accuracy lines must be carried from the farthest facility to a position abeam the changeover point, and these lines on each side of the airway or route segment at the COP are joined by lines drawn directly from the nearer facility. In this case the angles of the lines drawn from the nearer facility have no specific angle. See Figure 17-13.

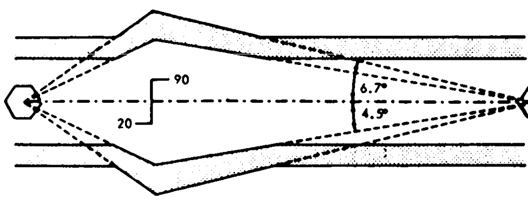


Figure 17-13. OFFSET COP. Par 1716.c.

d. Dogleg Segment. A dogleg airway or route segment may be treated in a manner similar to that given offset COPs. The system accuracy lines will be drawn to meet at a line drawn as the bisector of the dogleg "bend" angle and the boundaries of the primary and secondary areas extended as required. See Figure 17-14.

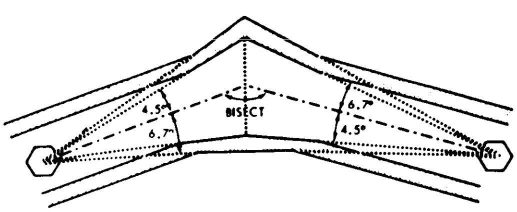


Figure 17-14. DOGLEG SEGMENT. Par 1716.d.

1717. COURSE CHANGE EFFECT. The complexity of defining the obstacle clearance areas is increased when the airway or route becomes more complex. Figure 17-15 shows the method of defining the primary area when a radio fix and a COP are involved. Note that the system accuracy lines are drawn from the farthest facility

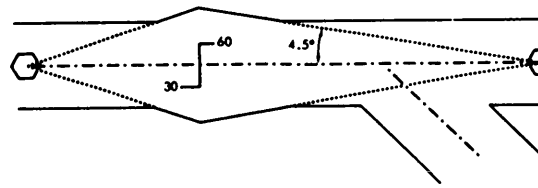
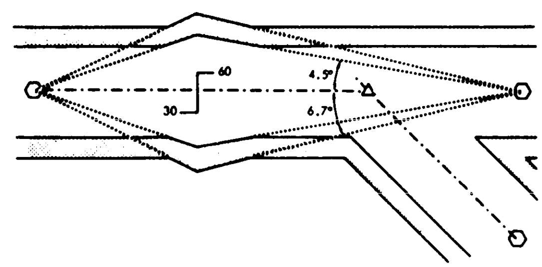


Figure 17-15. COURSE CHANGE EFFECT. Par 1717.

first, and govern the width of the airway or route at the COP. The application of secondary area criteria results in a segment similar to that depicted in Figure 17-16.



* Figure 17-16. APPLICATION OF SECONDARY AREAS Par 1717 *

1718. MINIMUM ENROUTE INSTRUMENT ALTITUDES (MEA). An MEA will be established for each segment of an airway/route from radio fix to radio fix. The MEA will be established based upon obstacle clearance over the terrain or over manmade objects, adequacy of navigation facility performance, and communications requirements. Segments are designated West to East and South to North. Altitudes will be established to the nearest 100 foot increment; i.e., 2049 feet becomes 2000, and 2050 feet becomes 2100.

NOTE: Care must be taken to insure that all MEAs based upon flight inspection information have been corrected to and reported as true altitudes above mean sea level (MSL).

1719. PROTECTED ENROUTE AREAS. As previously established, the enroute areas which must be considered for obstacle clearance protection are identified as primary, secondary, and turn areas. The overall consideration of these areas is necessary when determining obstacle clearances.

Section 2. VHF Obstacle Clearance

1720. OBSTACLE CLEARANCE, PRIMARY AREA.

a. Nonmountainous Areas. The minimum obstacle clearance over areas NOT designated as mountainous under FAR 95 will be 1000 feet over the highest obstacle.

b. Mountainous Areas. Owing to the action of Bernoulli Effect and of atmospheric eddies, vortices, waves, and other phenomena which occur in conjunction with the disturbed airflow attending the passage of strong winds over mountains, pressure deficiencies manifested as very steep horizontal pressure gradients develop over such regions. Since downdrafts and turbulence are prevalent under these conditions, the hazards to air navigation are multiplied. Except as set forth in (1) and (2) below, the minimum obstacle clearance over terrain and manmade obstacles, within areas designated in FAR 95 as "mountainous" will be 2000 feet.

(1) Obstacle clearance may be reduced to not less than 1500 feet above terrain in the designated mountainous areas of the Eastern United States, Commonwealth of Puerto Rico, and the land areas of the State of Hawaii; and may be reduced to not less than 1700 feet above terrain in the designated mountainous areas of the Western United States and the State of Alaska. Consideration must be given to the following points before any altitudes providing less than 2000 feet of terrain clearance are authorized.

(a) Areas characterized by precipitous terrain.

(b) Weather phenomena peculiar to the area.

(c) Phenomena conducive to marked pressure differentials.

(d) Type of and distance between navigation facilities.

(e) Availability of weather services throughout the area.

(f) Availability and reliability of altimeter resetting points along airways/routes in the area.

(2) Altitudes providing at least 1000 feet of obstacle clearance over towers and/or other manmade obstacles may be authorized within designated mountainous areas provided such obstacles are NOT located on precipitous terrain where Bernoulli Effect is known or suspected to exist.

NOTE: When approving MEAs with less than 2000 feet of obstacle clearance in designated mountainous areas, a record of such approval will be maintained by the Flight Inspection Field Office.

1721. OBSTACLE CLEARANCE, SECONDARY AREAS. In all areas, mountainous and nonmountainous, obstacles which are located in the secondary areas will be considered as obstacles to air navigation when they extend above the secondary obstacle clearance plane. This plane begins at a point 500 feet above the obstacles upon which the primary obstacle clearance area MOCA is based, and slants upward at an angle which will cause it to intersect the outer edge of the secondary area at a point 500 feet higher. See Figure 17-17. Where an obstacle extends above this plane, the normal MOCA shall be increased by adding to the MSL height of the highest penetrating obstacle in the secondary area the required clearance (C), computed with the following formula:

$$\frac{D^1}{D^2} = \frac{500}{C} \text{ or } C = \frac{500 \times D^2}{D^1}$$

D^1 is the total width of the secondary area.

D^2 is the distance from the obstacle to the OUTER edge of the secondary area.

NOTE: Add an extra 1000 feet in mountainous areas except where MEAs in enroute airspace *areas are reduced under the provisions of paragraph 1720. In these cases, where the primary area MOCA has been reduced to 1700 feet, add 700 feet to the secondary obstacle clearance, and where the primary area MOCA has been reduced to 1500 feet, add 500 feet to the secondary area clearance value.*

D^1 has a total width of 2 NM, or 12,152 feet out to a distance of 51 NM from the enroute facility, and then increases at a rate of 236 feet for each additional NM.

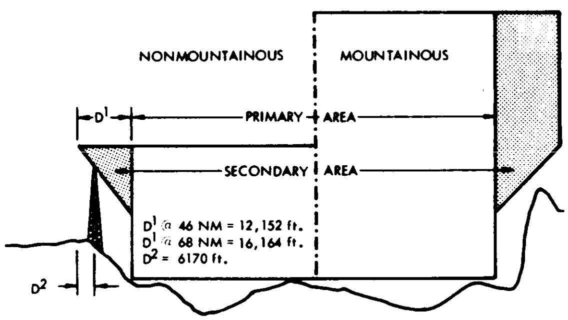


Figure 17-17. CROSS SECTION, SECONDARY AREA OBSTACLE CLEARANCES. Par 1721.

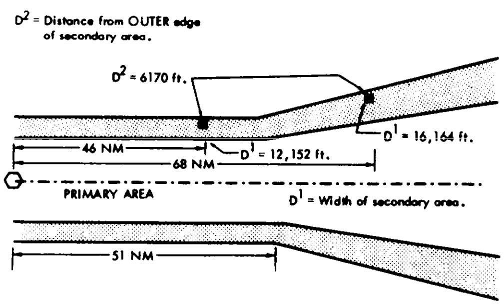


Figure 17-18. PLAN VIEW, SECONDARY AREA OBSTACLE CLEARANCES. Par 1721.

Example: An obstacle which reaches 1875 feet MSL is found in the secondary area 6170 feet inside the outer secondary area boundary and 46 NM from the facility. See Figures 17-17 and 17-18.

D^1 is 12,152 feet.
D^2 is 6170 feet.

$$\frac{500 \times 6170}{12{,}152} = 253.8 \text{ (254 feet)}$$

Obstacle height (1875) + 254 = 2129.
MOCA is 2100 feet.

1722. OBSTACLE CLEARANCE GRAPH. Figure 17-19 is a secondary area obstacle clearance graph, designed to allow the determination of clearance requirements without using the formula. The left axis shows the required obstacle clearance; the lower axis shows the distance from the outer edge of the secondary area to the obstacle. The slant lines are facility distance references.

Facility distances which fall between the charted values may be found by interpolation along the vertical distance lines.

a. Application. To use the secondary area obstacle clearance chart, enter with the value representing the distance from the outer edge of the secondary area to the obstacle. In the problems above this distance was 6170 feet. Proceed up to the "51 NM or less" line and read the clearance requirement from the left axis. The chart reads 254 feet, the same as was found using the formula. To solve the second problem, reenter the chart at 6170 feet and move vertically to find 68 NM between the 60 and 70 NM facility distance slant lines. The clearance requirement shown to the left is 191 feet, the same as found using the formula.

b. Finding the MOCA. The required clearance, found by using the graph, is now added to the MSL height of the obstacle to get the MOCA:

(1) 46 NM from facility:
254 + 1875 = 2129 (2100 MSL).

(2) 68 NM from facility:
191 + 1875 = 2066 (2100 MSL).

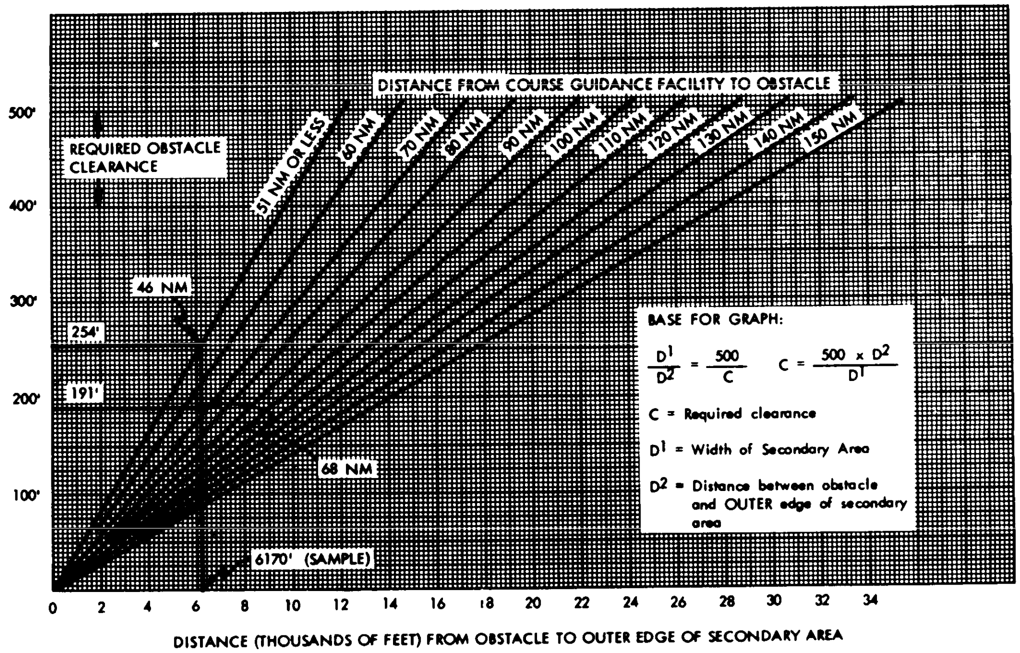


Figure 17-19. SECONDARY AREA OBSTACLE CLEARANCE. Par 1722.

1723.-1729. RESERVED.

Section 3. Altitudes

*

1730. MINIMUM CROSSING ALTITUDES (MCA). It is necessary to establish MCAs in all cases where obstacles intervene to prevent a pilot from maintaining obstacle clearance during a normal climb to a higher MEA after the aircraft passes a point beyond which the higher MEA applies. The same vertical obstacle clearance requirement for the primary and secondary areas must be considered in the determination of the MCA. See paragraph 1718. The standard for determining the MCA shall be based upon the following climb rates, and is computed from the flight altitude:

SL through 5000 feet	150 ft/NM
5000 through 10,000 feet	120 ft/NM
10,000 feet and over	100 ft/NM

a. To determine the MCA, the distance from the obstacle to the radio fix shall be computed from the point where the centerline of the en route course in the direction of flight intersects the farthest displacement from the fix. See Figures 17-20 and 17-21.

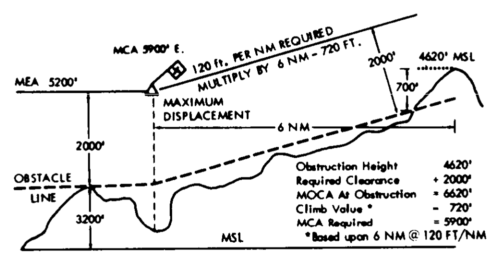


Figure 17-20. MCA DETERMINATION POINT. Par 1730.

*

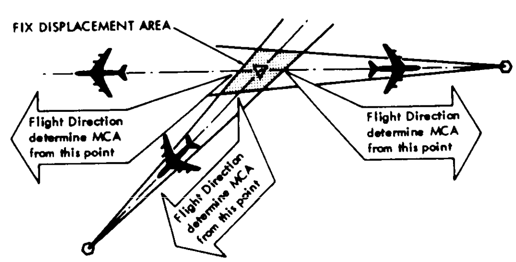


Figure 17-21. DETERMINATION OF MCA. Par 1730.

b. When a change of altitudes is involved with a course change, course guidance must be provided if the change of altitude is more than 1500 feet and/or if the course change is more than 45 degrees.

EXCEPTION: Course changes of up to 90 degrees may be approved without course guidance provided that no obstacles penetrate the established MEA requirement of the previous airway/route segment within 15 NM of the boundaries of the system accuracy displacement area of the fix. See Figure 17-22 and paragraph 1740.b.(2).

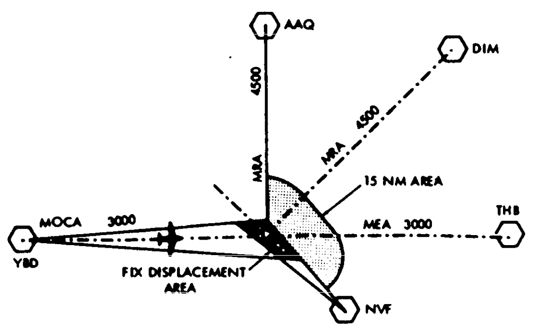


Figure 17-22. MEA WITH NAVIGATION GAP AT TURNING POINT. Par 1740.b.(2).

1731. ENROUTE MINIMUM HOLDING ALTITUDES. Criteria for holding pattern airspace are contained in FAA Handbook 7130.3 and provide for separation of aircraft from aircraft. The criteria contained herein deal with the clearance of holding aircraft from obstacles.

a. Area. The primary obstacle clearance area for holding shall be based on the appropriate holding pattern airspace area specified in FAA Handbook 7130.3, Holding Pattern Criteria. No reduction in the pattern sizes for "on-entry" procedures is permitted. In addition, when holding is at an intersection fix, the selected pattern shall also be large enough to contain at least 3 corners of the fix displacement area. See paragraphs 284, 285, and Figure 37. A secondary area 2 miles wide surrounds the perimeter of the primary area.

b. Obstacle Clearance. The minimum obstacle clearance of the route shall be provided throughout the primary area. In the secondary area 500 feet of obstacle clearance shall be provided at the INNER edge, tapering to zero feet at the outer edge. For computation of obstacle clearance in the secondary area, see Appendix 2, paragraph 5 for use of Figure 123. Allowance for precipitous terrain should be considered as stated in paragraph 323.a. The altitudes selected by application of the obstacle clearance specified in this paragraph may be rounded to the nearest 100 feet.

c. Communications. The communications on appropriate ATC frequencies (as determined by ATS) shall be required throughout the entire holding pattern area from the MHA up to and including the maximum holding altitude. If the communications are not satisfactory at the minimum holding obstacle clearance altitude, the MHA shall be authorized at an altitude where the communications are satisfactory. For communications to be satisfactory, they must meet the standards as set forth in FAA Handbook OA P 8200.1, The U.S. Standard Flight Inspection Manual.

d. Holding Patterns On/Adjacent to ILS Courses. Holding patterns on or adjacent to ILS courses shall comply with FAA Handbook 7130.3, Holding Pattern Criteria, paragraph 54.

e. High Altitude. All holding patterns in the high altitude structure shall be coordinated with the Flight Standards National Field Office prior to being approved.

1732.-1739. RESERVED.

Section 4. Navigational Gaps

1740. NAVIGATIONAL GAP CRITERIA. Where a gap in course guidance exists, an airway or route segment may be approved in accordance with the criteria set forth in 1740.c., provided:

a. Restrictions.

(1) The gap may not exceed a distance which varies directly with altitude from zero NM at sea level to 65 NM at 45,000 feet MSL, and;

(2) Not more than one gap may exist in the airspace structure for the airway/route segment, and;

(3) A gap may not occur at any airway or route turning point, except when the provisions of paragraph 1740.b.(2) are applied, and;

(4) A notation must be included on FAA Form 8260-16 which specifies the area within which a gap exists where the MEA has been established with a gap in navigational signal coverage. The gap area will be identified by distances from the navigation facilities.

b. Authorizations. MEAs with gaps shall be authorized only where a specific operational requirement exists. Where gaps exceed the distance in 1740.a.(1), or are in conflict with the limitations in 1740.a.(2) or (3), the MEA must be increased as follows:

(1) For straight segments:

(a) To an altitude which will meet the distance requirement of 1740.a.(1), or;

(b) When in conflict with 1740.a.(1) or (2) to an altitude where there is continuous course guidance available.

(2) For turning segments. Turns to intercept radials with higher MEAs may be allowed provided:

(a) The increase in MEA does not exceed 1500 feet, and;

(b) The turn does not exceed 90 degrees, and;

(c) No obstacles penetrate the MEA of the course being flown within 15 NM of the fix displacement area. See Figure 17-22.

(3) When in conflict with 1740.b.(1) or (2) to an altitude where there is continuous course guidance available.

c. Use of Steps. Where large gaps exist which require the establishment of altitudes which obviate the effective use of airspace, consideration may be given to the establishment of MEA

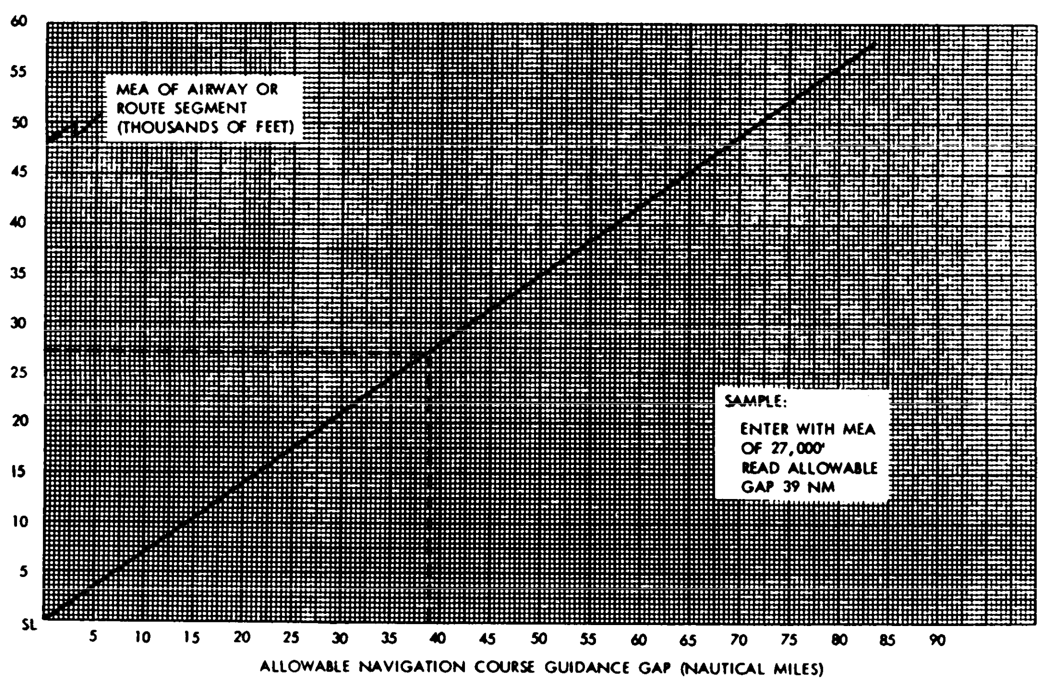


Figure 17-23. NAVIGATION COURSE GUIDANCE GAPS. Par 1740.

"steps." These steps may be established at increments of not less than 2000 feet below 18,000 feet MSL, or not less than 4000 feet at 18,000 feet MSL and above, provided that a total gap does not exist for the segment within the airspace structure. MEA steps shall be limited to one step between any two facilities to eliminate continuous or repeated changes of altitude in problem areas. MEA changes shall be identified by designated radio fixes.

d. Gaps. Allowable navigational gaps may be determined by reference to the graph in Figure 17-23.

Example: The problem drawn on the chart shows the method used to determine the allowable gap on a route segment with a proposed MEA of 27,000 feet. Enter the graph at the left edge with the MEA of 27,000 feet. Move to the right to the interception of the diagonal line. Move to the bottom of the graph to read the allowable gap. In the problem drawn, a 39 NM gap is allowable.

1741.-1749. RESERVED.

Section 5. Low Frequency Airways or Routes

1750. LF AIRWAYS OR ROUTES.

a. Usage. LF navigation facilities may be used to establish enroute airway/route segments. Then use will be limited to those instances where an operational requirement exists.

b. Obstacle Clearance Areas. See Figures 17-24 and 17-25.

(1) The primary obstacle clearance area boundaries of LF segments are lines drawn 4.34 NM (5 statute miles) on each side of and parallel to the segment centerline. These boundaries will be affected by obstacle clearance area factors shown in c. below.

(2) The LF secondary obstacle clearance areas extend laterally for an additional 4.34 NM on each side of the primary area. The boundaries of the secondary areas are also affected by the obstacle clearance area factors shown in c. below.

c. Obstacle Clearance Area Factors. See Figures 17-24 and 17-25.

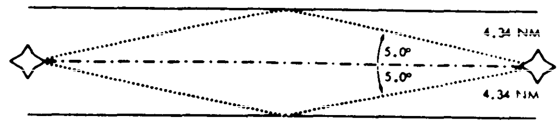


Figure 17-24. LF SEGMENT PRIMARY OBSTACLE CLEARANCE AREA. Par 1750.b.

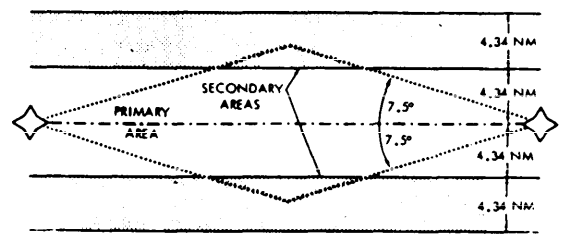


Figure 17-25. LF SEGMENT SECONDARY OBSTACLE CLEARANCE AREA. Par 1750.b.

(1) The primary area of LF segments is expanded in the same way as for VHF airways/routes. Lines are drawn at 5 degrees off the course centerline from each facility. These lines meet at the midpoint of the segment. Penetration of the 4.34 NM boundary occurs 49.66 (50) NM from the facility.

(2) The secondary areas are expanded in the same manner as the secondary areas for VHF airways/routes. Lines are drawn 7.5 degrees on each side of the segment centerline. These 7.5 degree lines will intersect the original 8.68 NM secondary area boundaries at 65.93 (66) NM from the facility.

d. Obstacle Clearance.

(1) Obstacle clearance in the primary area of LF airways or routes is the same as that required for VOR airways/routes. The areas over which the clearances apply are different, as shown in paragraph 1750.c.

(2) Secondary area obstacle clearance requirements for LF segments are based upon distance from the facility and location of the obstacle relative to the inside boundary of the secondary area.

(a) Within 25 NM of the facility the obstacle clearance is based upon a 50:1 plane drawn from the primary area boundary 500 feet above the obstacle which dictates its MOCA and extending to the edge of the secondary area. When obstacles penetrate this 50:1 plane, the MOCA for the segment will be increased above that dictated for the primary area obstacle as follows:

Distance from Primary Boundary	Add to Height of Obstacle
0 - 1 statute miles	500 feet
1 - 2 statute miles	400 feet
2 - 3 statute miles	300 feet
3 - 4 statute miles	200 feet
4 - 5 statute miles	100 feet

NOTE: See Figure 17-26 for cross section view. Also see (c) below.

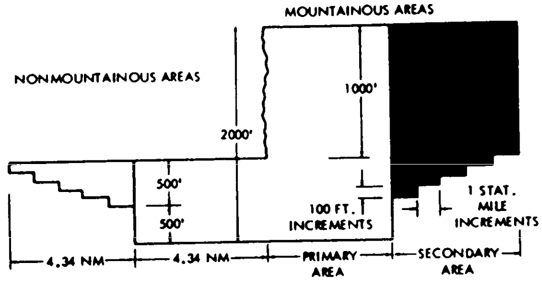


Figure 17-26. LF SEGMENT OBSTACLE CLEARANCE WITHIN 25 NM OF ENROUTE FACILITY.
Par 1750.d.

(b) Beyond the 25 NM distance from the facility, the secondary obstacle clearance plane is flat. This plane is drawn from the primary area boundary 500 feet above the obstacle which dictates its MOCA and extending to the edge of the secondary area. If an obstacle penetrates this surface the MOCA for the segment will be increased so as to provide 500 feet of clearance over the obstacle. See Figure 17-27. Also see (c) below.

(c) Obstacle clearance values shown in (a) and (b) above are correct for nonmountainous areas only. For areas designated as mountainous add 1000 feet.

1751.-1759. RESERVED.

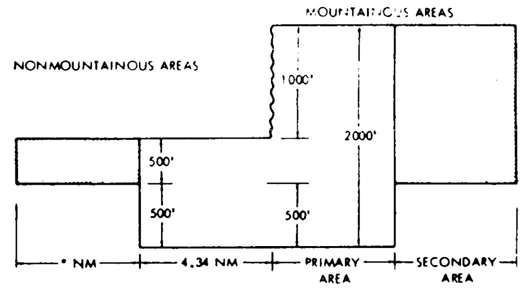


Figure 17-27. LF SEGMENT OBSTACLE CLEARANCE OVER 25 NM FROM ENROUTE FACILITY.
Par 1750.d.

Section 6. Minimum Divergence Angles

1760. GENERAL.

a. Governing Facility. The governing facility for determining the minimum divergence angle depends upon how the fix is determined.

(1) Where the fix is predicated on an off-course radial or bearing, the distance from the fix to the facility providing the off-course radial or bearing is used.

(2) Where the fix is predicated on the radials or bearings of two intersecting airways or routes, the distance between the farthest facility and the fix will be used to determine the angle.

b. Holding. Where holding is to be authorized at a fix, the minimum divergence angle is 45 degrees.

1761. VHF FIXES.

a. The minimum divergence angles for those fixes formed by intersecting VHF radials are determined as follows:

(1) When both radio facilities are located within 30 NM of the fix, the minimum divergence angle is 30 degrees.

(2) When the governing facility is over 30 NM from the fix, the minimum allowable angle will be increased at the rate of 1 degree per NM up to 45 NM (45 degrees).

(3) Beyond 45 NM, the minimum divergence angle increases at the rate of 1/2 degree per NM.

Example: Distance from fix to governing facility is 51 NM. 51 − 45 = 6 NM. 6 × 1/2 = 3 additional degrees. Add to the 45 degrees required at 45 NM and get 48 degrees minimum divergence angle at 51 NM.

b. A graph (Figure 17-28) may be used to define minimum divergence angles. Using the foregoing example, enter the chart at the bottom with the facility distance (51 NM). Move up to the "VHF Fix" conversion line. Then move to the left to read the angle – 48 degrees.

1762. LF OR VHF/LF FIXES.

a. Minimum divergence angles for LF or integrated (VHF/LF) fixes are determined as follows:

(1) When the governing facility is within 30 NM of the fix, the minimum divergence angle is 45 degrees.

(2) Beyond 30 NM the minimum angle must be increased at the rate of 1 degree for each NM, except for fixes on long overwater routes where the fix will be used for reporting purposes and not for traffic separation.

Example: The distance from the governing facility is 51 NM. 51 − 30 = 21 NM. 21 × 1 = 21. Add 21 to 45 degrees required at 30 NM to get the required divergence angle of 66 degrees.

b. The graph (Figure 17-28) may be used to define minimum angles for LF or VHF/LF fixes. Using the foregoing example, enter at the bottom of the chart with the 51 NM distance between facility and fix. Move up to the "LF or INTEGRATED FIX" conversion line, then left to read the required divergence angle, 66 degrees.

1763.-1799. RESERVED.

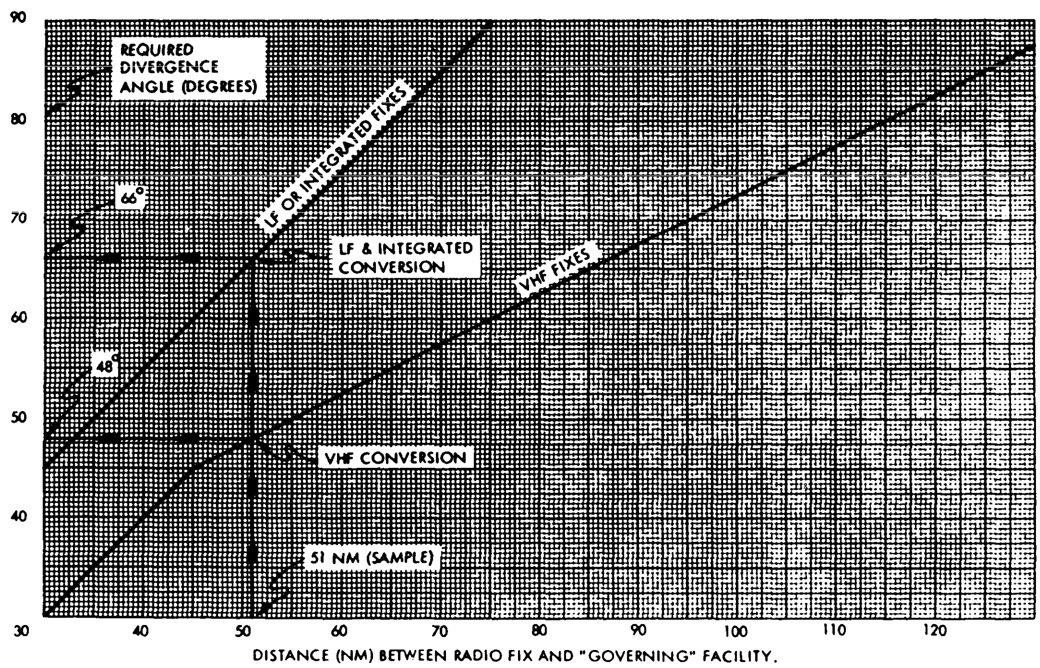


Figure 17-28. MINIMUM DIVERGENCE ANGLE FOR RADIO FIX. Par 1761.b. and 1762.b.